Acceptance correction for the dilepton combinatorial background in HADES*

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In 2012 HADES [1] has measured Au+Au collisions at a beam kinetic energy of 1.23 GeV/u. In the data analysis, single e^+/e^- tracks are identified by an appropriate selection cut in a multivariate feature space of RICH ring observables, time-of-flight, PreShower and energy loss signals, provided by corresponding detectors [2].

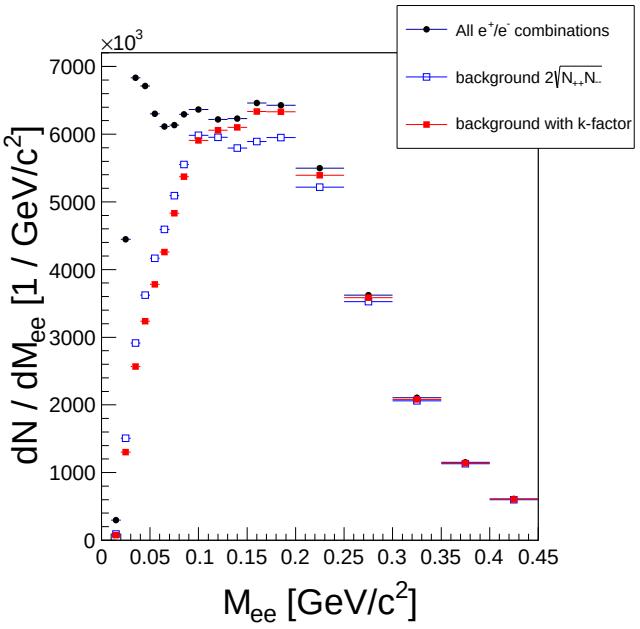

Figure 1: Invariant mass of all e^+/e^- combinations and CB calculated as geometrical average of e^+e^+ and e^-e^- yields and also weighted with the k-factor.

In heavy-ion collisions the only viable method for extracting the signal of correlated e^+/e^- pairs is to combine all e^+ and e^- in the event and then, from final spectra (invariant mass, rapidity, transverse momentum etc.), subtract the contribution due to combinatorial background (CB). The background can be estimated as $N^{\mathrm{bgr}}_{+-} = 2\sqrt{N_{++}N_{--}}k$ with $k = \frac{\kappa_{+-}}{2\sqrt{\kappa_{++}\kappa_{--}}}$, where N's represent yields of like-sign lepton pairs and κ's are acceptances of the detector system for pairs of different signs. Here only the ratios of acceptances are involved, so it is enough to compare yields of uncorrelated pairs of different signs obtained from event mixing [3].

In the current work we intend to prove the necessity of correcting the combinatorial background for the pair acceptance. Single track identification is performed in a way discussed in the Annual Report 2013 [2].

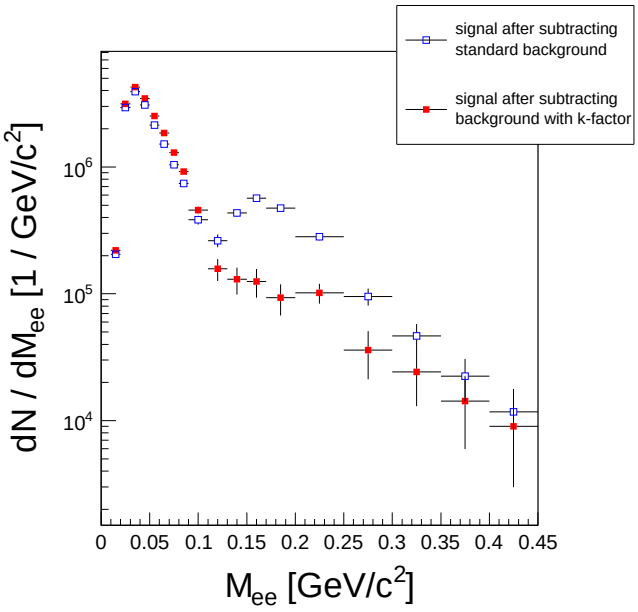

Figure 2: Invariant mass distribution of dilepton signal (not efficiency-corrected) after subtracting combinatorial background calculated in the two ways.

Fig. 1 shows the distribution of invariant mass of all e^+/e^- pair combinations and the combinatorial background calculated with the acceptance asymmetry factor k and without it. Background calculated in a simple way cannot follow the enhancement of the yield between 0.1 and 0.2 GeV/c^2. This is reflected also by signal spectra obtained after subtracting CB, as shown in Fig. 2, where an unphysical maximum appears at around 0.15 GeV/c^2.

As systematic study of the multi-differential behavior of the k-factor and its dependence on the way how the event mixing is performed and on the regions of the HADES acceptance is currently on-going.

References

[1] G. Agakishiev et al. (HADES Collaboration), Eur.Phys.J.A41:243-277, 2009

[2] S. Harabasz et al. "Electron identification in Au+Au collisions at 1.23 GeV/u in HADES using multivariate analysis", GSI Scientific Report 2013

[3] M. Köhler, Nucl. Phys. A931 (2014) 665-669

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